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Kuramoto et al.

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(54) **DEVELOPMENT UNIT, PROCESS CARTRIDGE AND IMAGE FORMING APPARATUS**

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(30) **Foreign Application Priority Data**

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G03G 15/08 (2006.01)
G03G 15/09 (2006.01)

(52) **U.S. Cl.** **399/104**; 399/254

(58) **Field of Classification Search** 399/104, 399/103, 254, 256

See application file for complete search history.

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(57) **ABSTRACT**

A development unit includes a developer accommodating part that accommodates a developer therein, a developer stirring-transporting member that transports the developer in the developer accommodating part while stirring the developer, a bearing part that receives a rotating shaft of the developer stirring-transporting member, a magnetic member that is located between the bearing part and the developer accommodating part and fixed around the rotating shaft, and a stirring member that is spaced apart from the magnetic member so as to be opposed to the magnetic member and that is arranged at the rotating shaft of the developer stirring-transporting member.

10 Claims, 6 Drawing Sheets

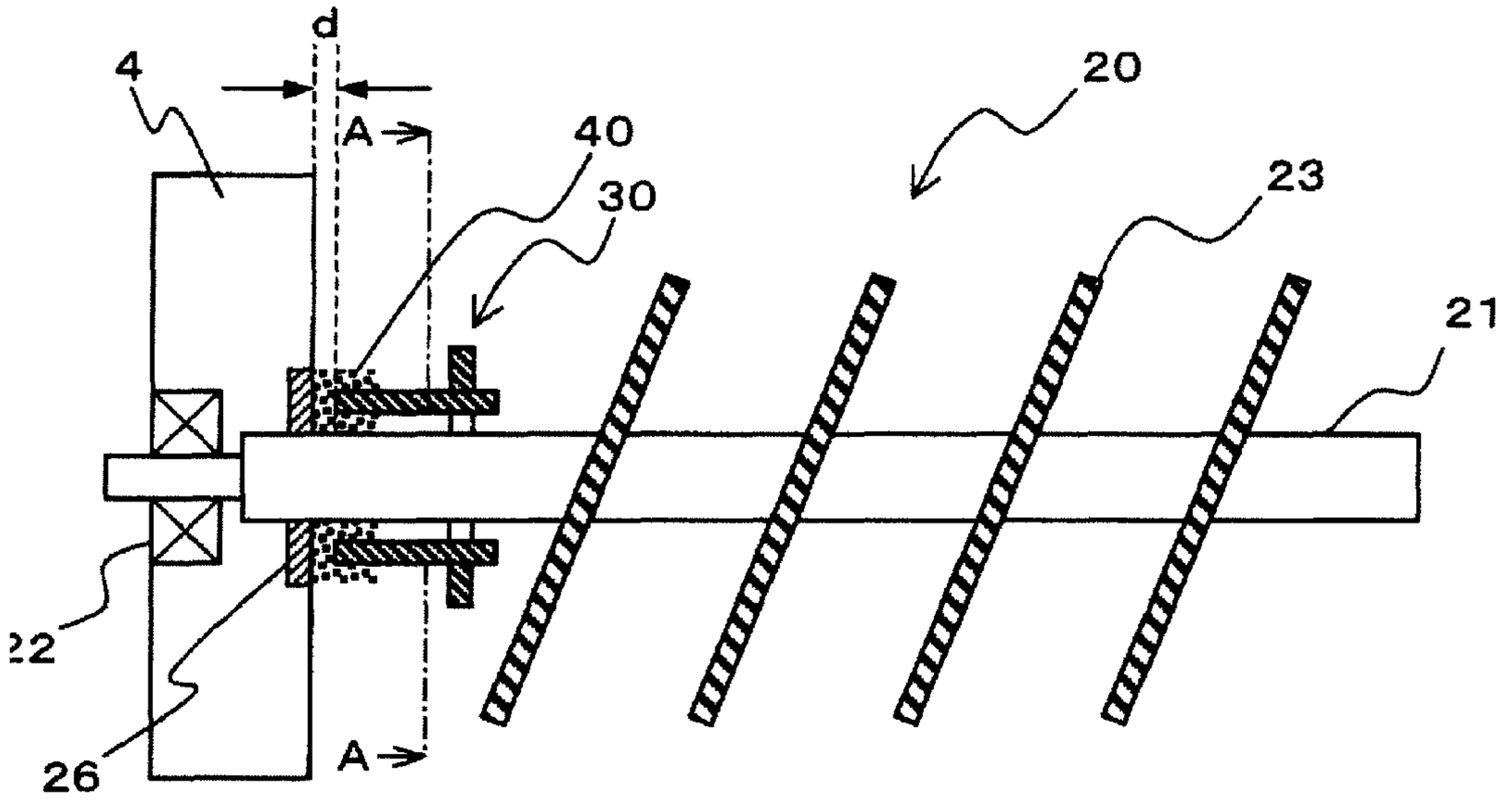


FIG.1

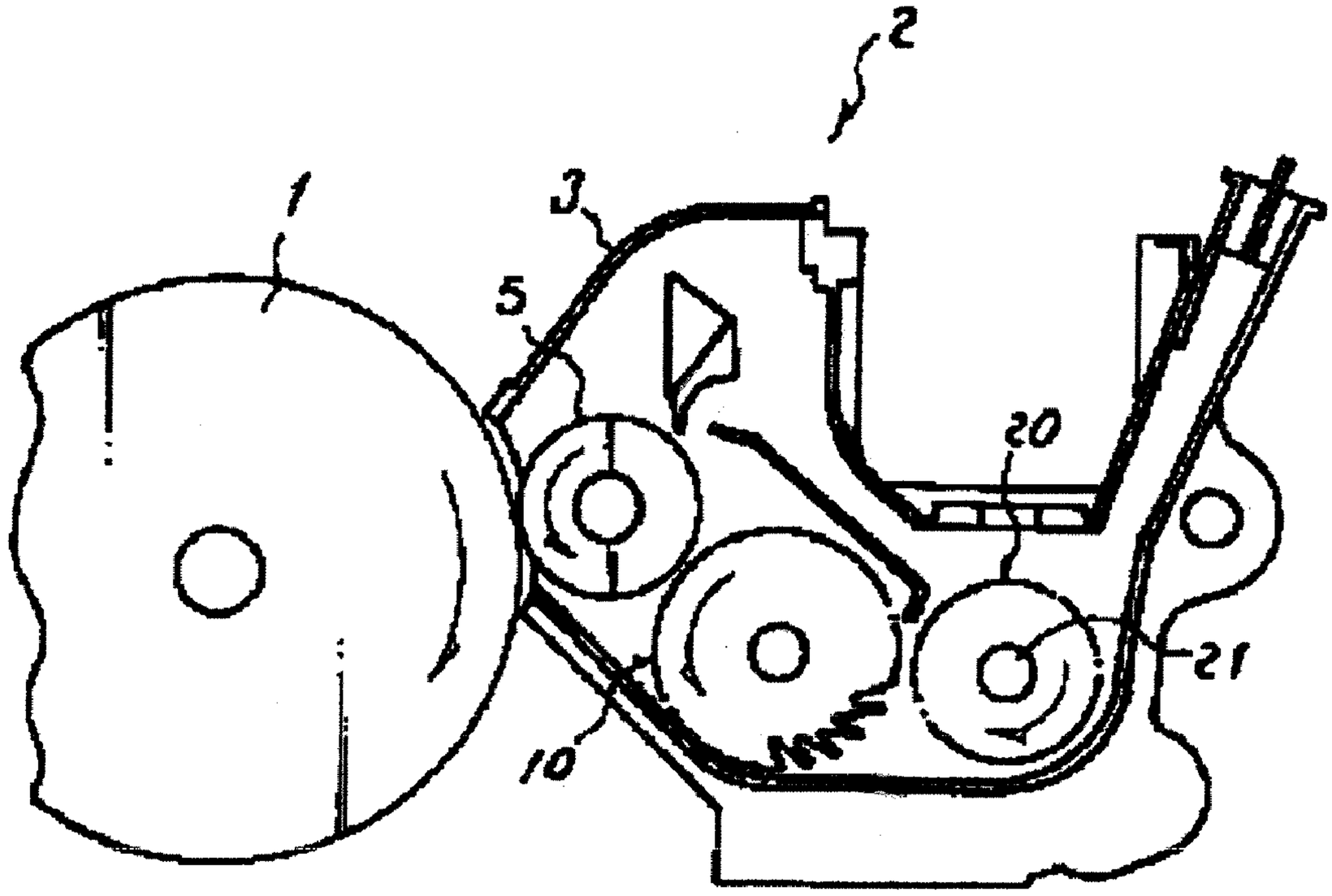


FIG.2

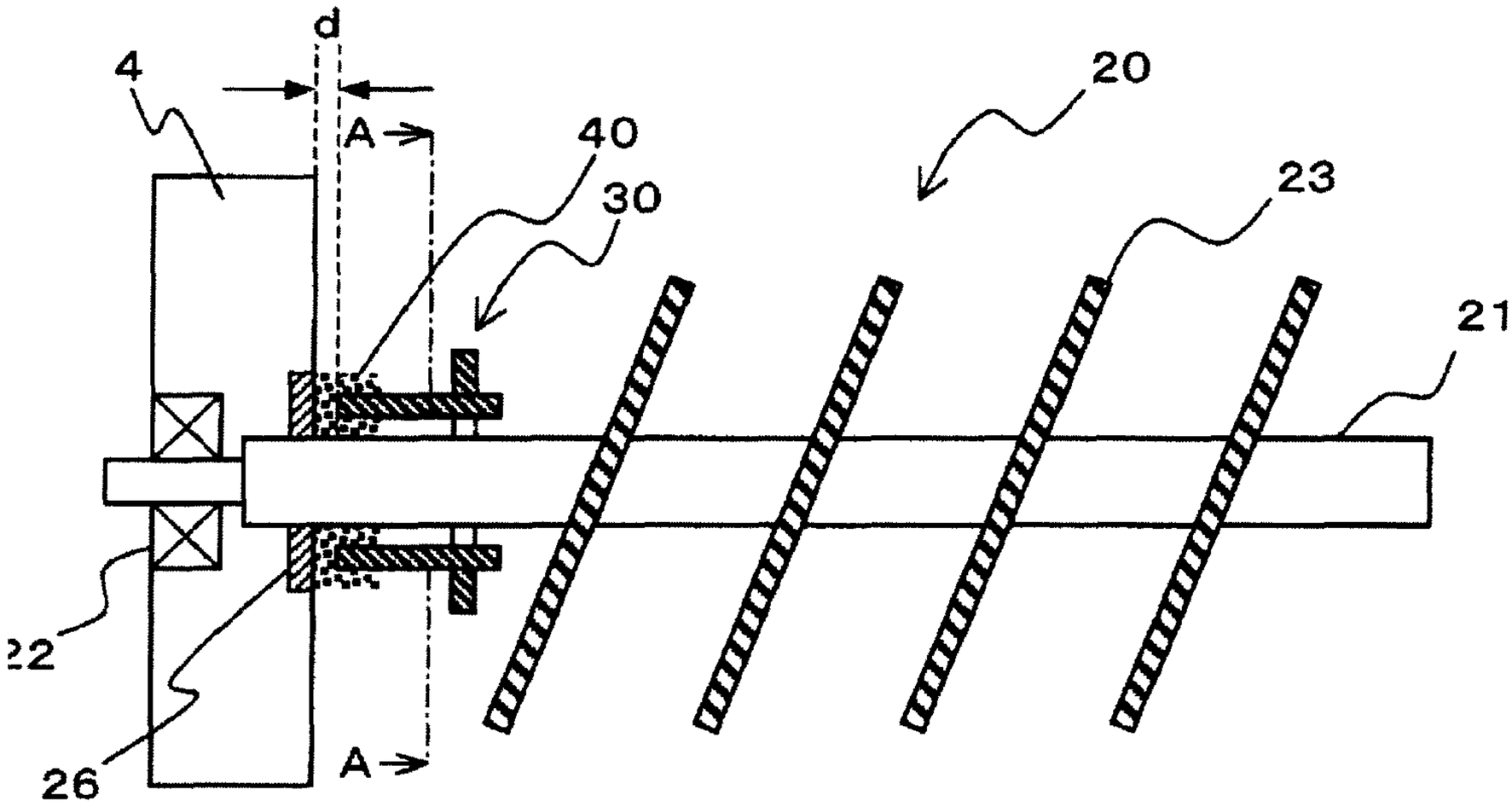


FIG.3

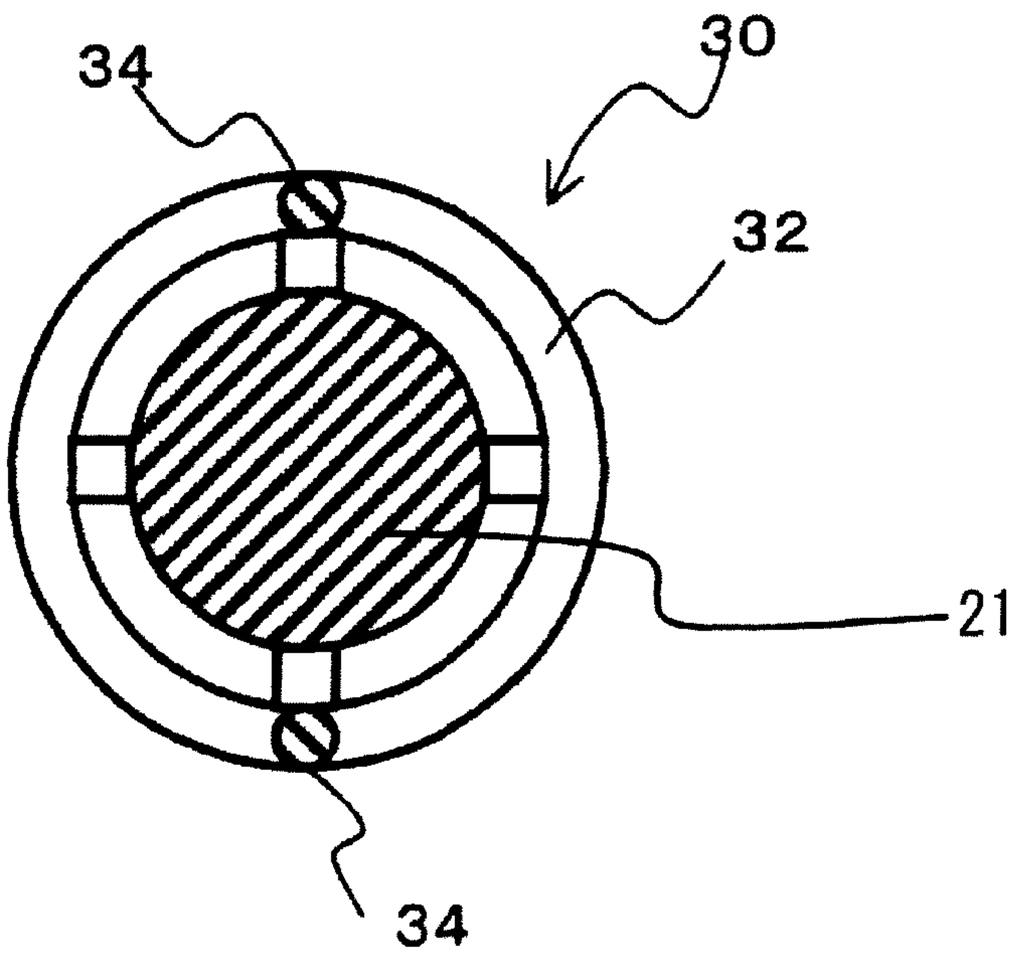


FIG.4

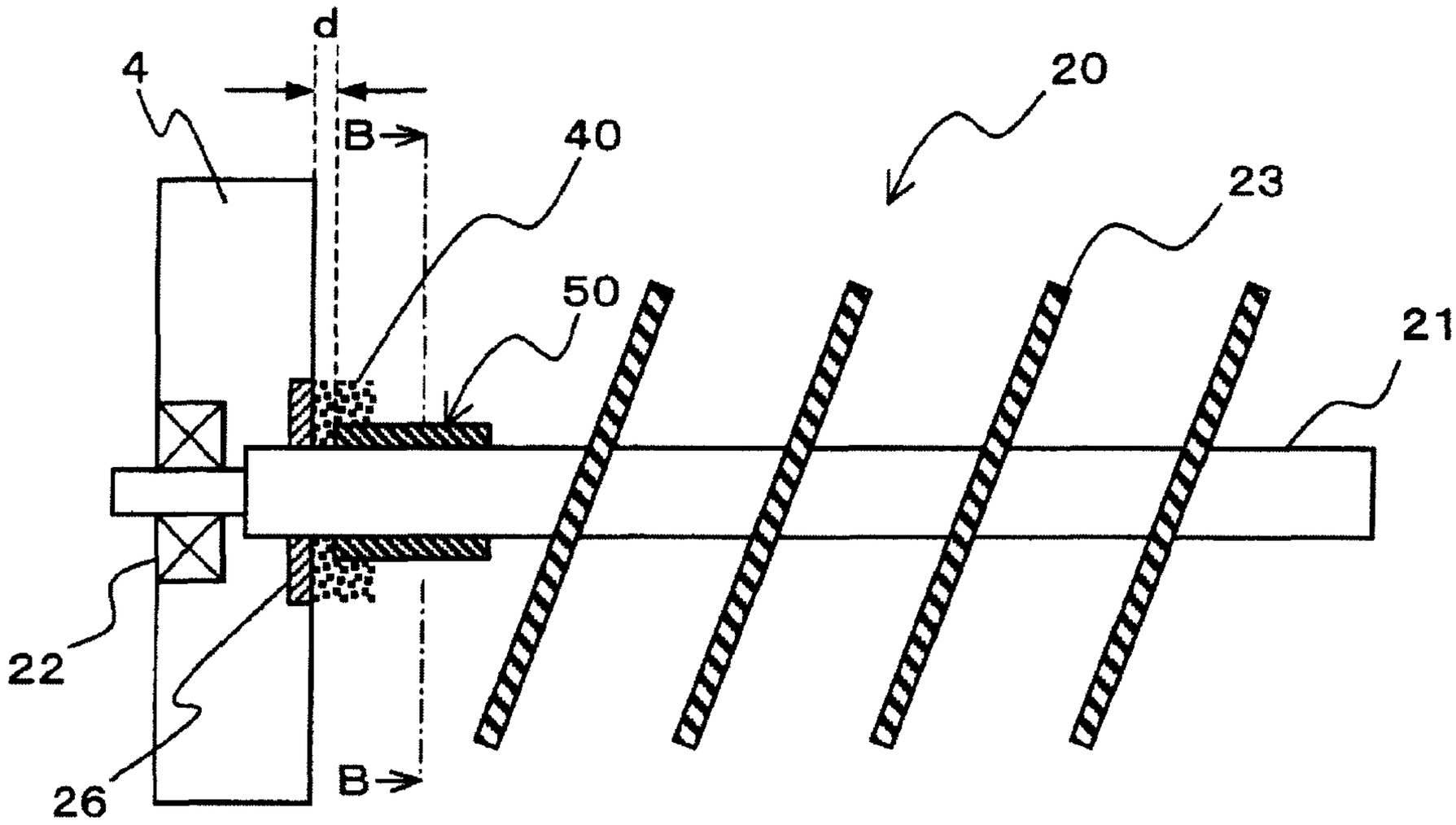


FIG.5

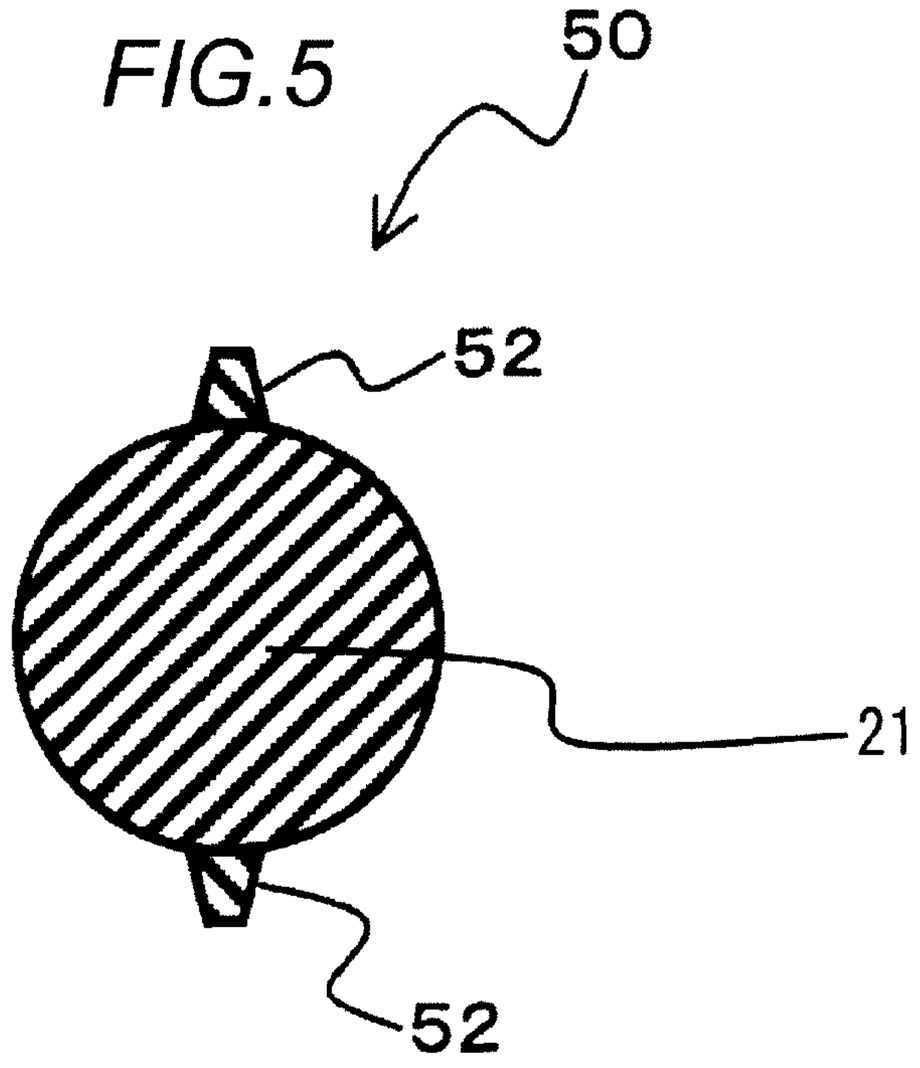


FIG.6

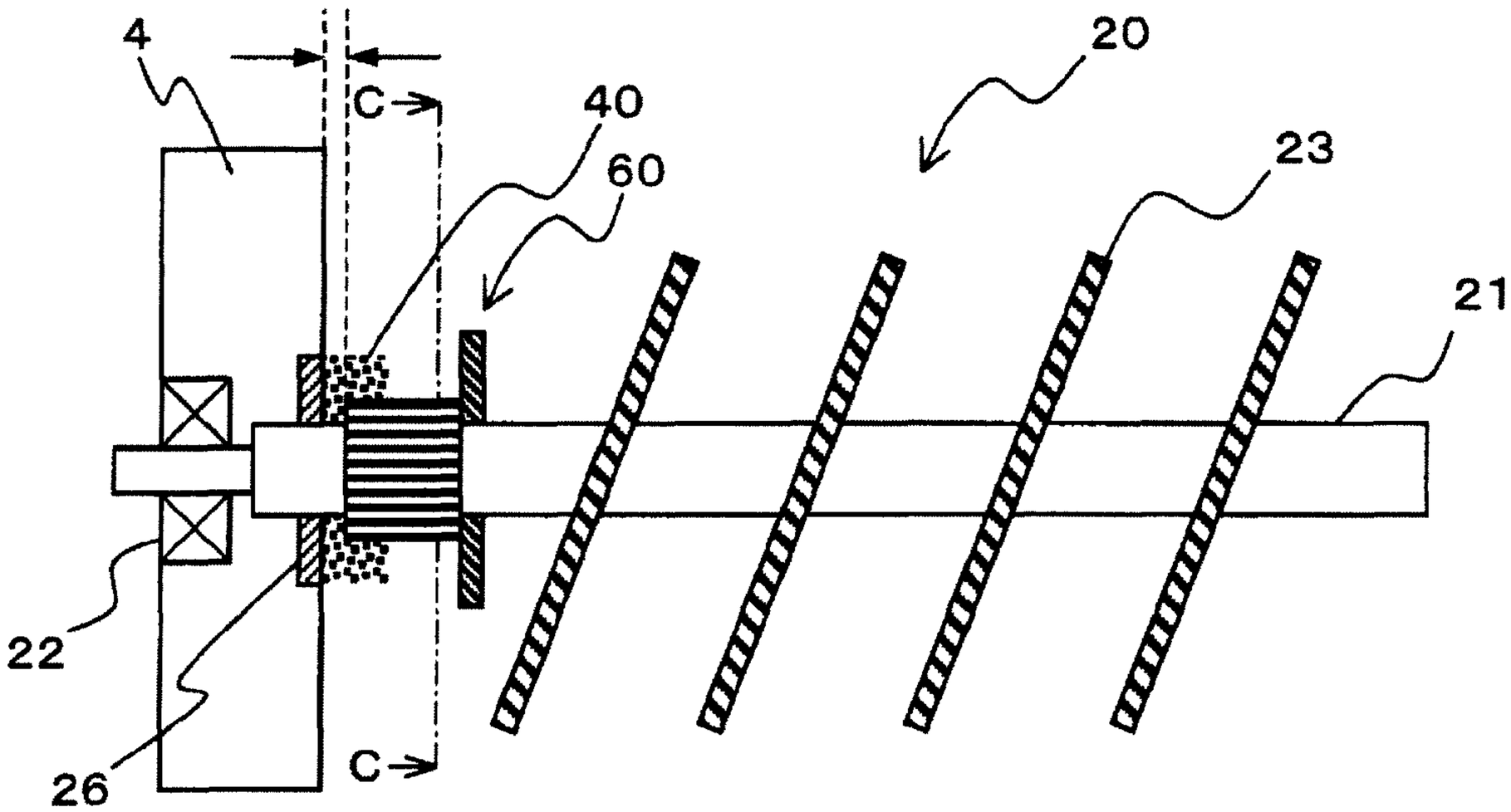


FIG.7

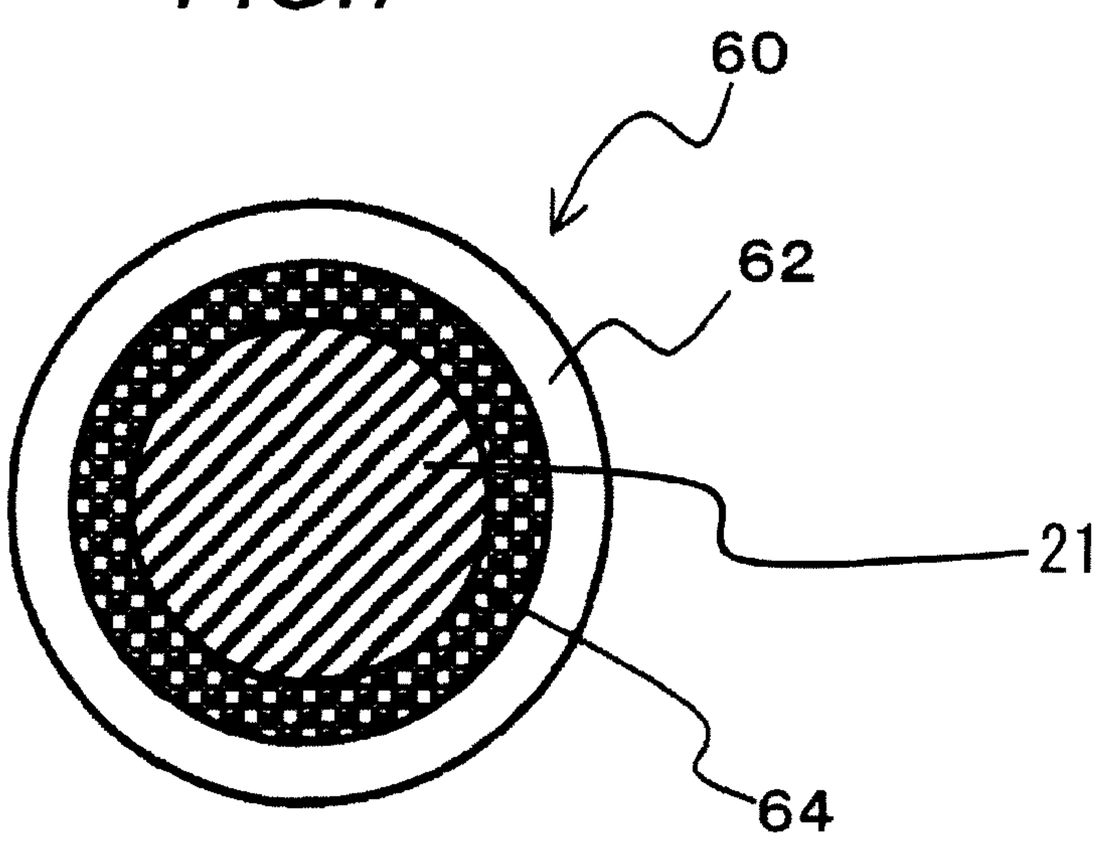


FIG.8

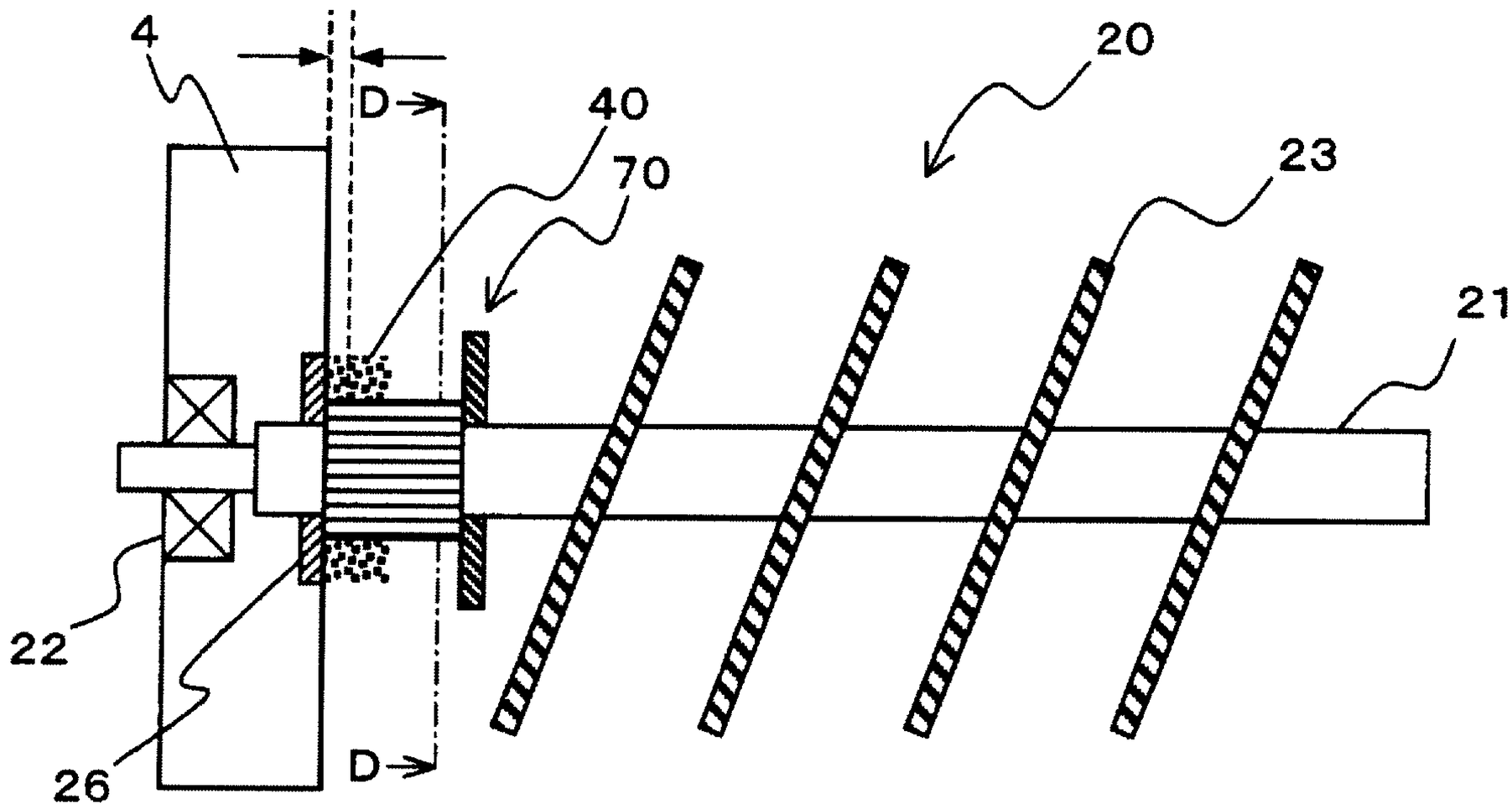


FIG.9

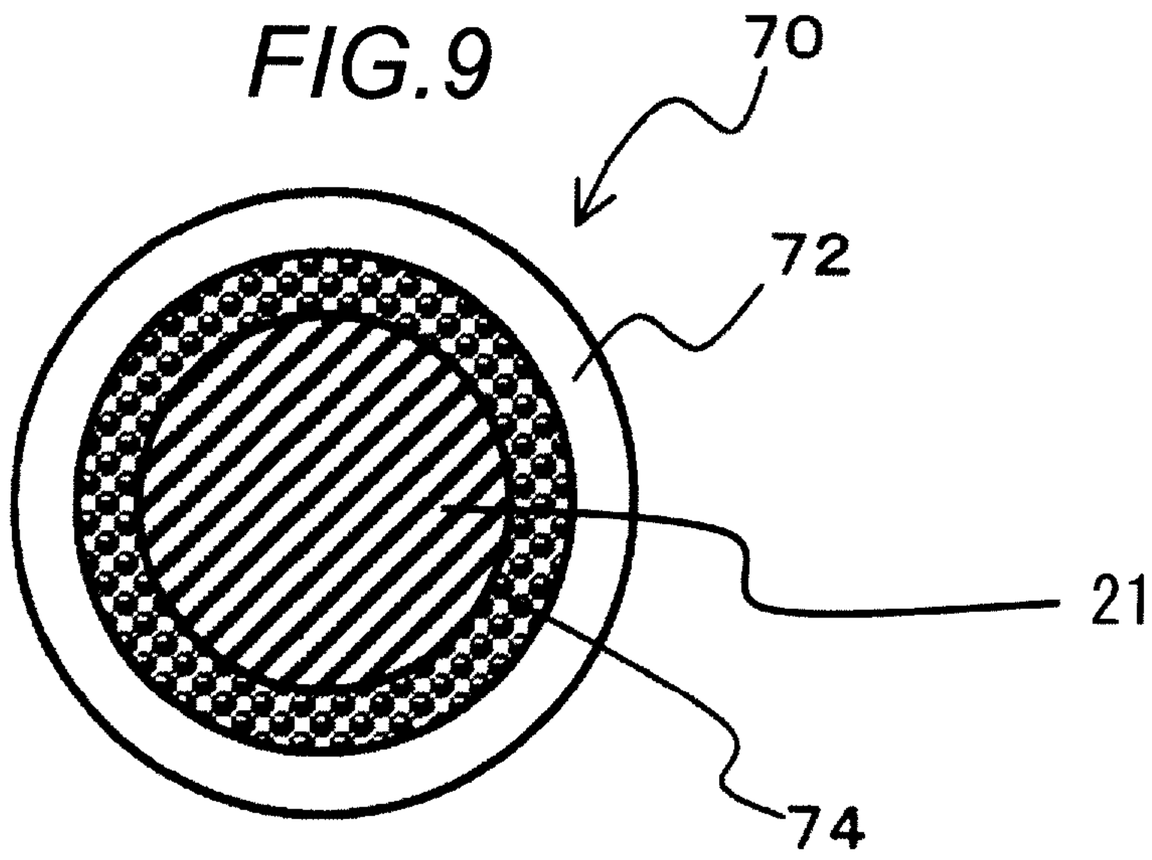
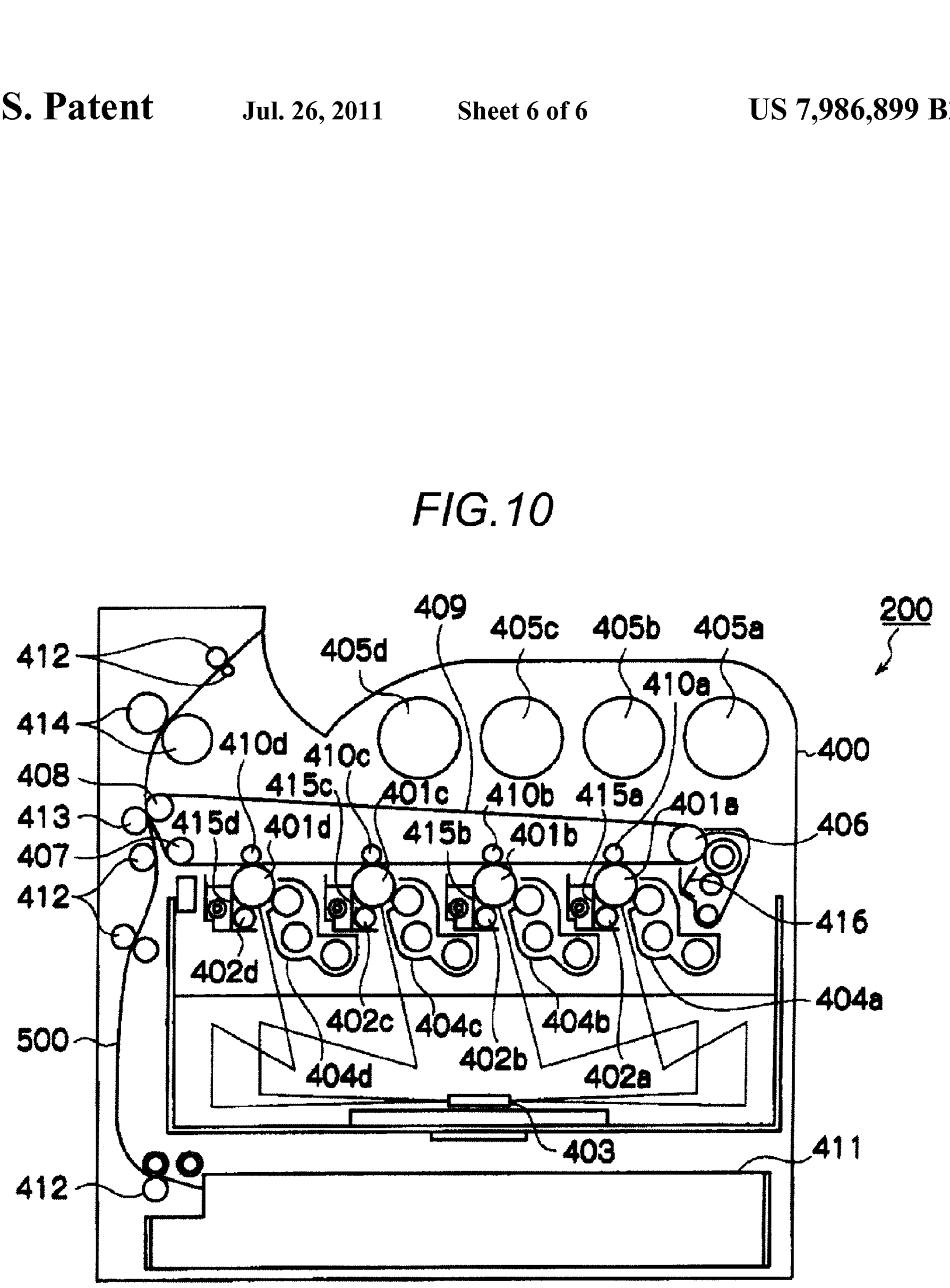


FIG. 10


200
409
405c
405b
405a
405d
412
410a
414
410d
410c
400
408
415c
401c
410b
415a
401a
413
415d
401d
415b
401b
406
407
412
416
402d
404a
402c
404c
404b
500
402b
404d
402a
403
411
412

DEVELOPMENT UNIT, PROCESS CARTRIDGE AND IMAGE FORMING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

This application is based on and claims priority under 35 USC 119 from Japanese Patent Application No. 2008-228840 filed Sep. 5, 2009.

BACKGROUND

1. Technical Field

The present invention relates to a development unit, a process cartridge and an image forming apparatus.

2. Related Art

In an image forming apparatus adopting an electrophotographic system, such as a copying machine or a printer, a toner image is formed on a charged body (for example, a photoreceptor), its toner image is transferred to a transferred body (for example, paper), and the toner image carried on the transferred body is fixed by a fixing unit. Herein, in order to form a toner image on the charged body, a development unit accommodating developer therein is arranged correspondingly to a development area of the charged body, and toner is made to fly from the development unit or the developer is rubbed, thereby to attach toner onto an electrostatic latent image formed on the charged body. On the other hand, as the developer, there are a single component developer composed of only magnetic toner or non-magnetic toner, and a two-component developer composed of toner and carrier.

In a development unit using the two-component developer, a developer stirring-transporting member is provided in a housing of the development unit. The developer stirring-transporting member of this stirring unit mixes the two-component developer in the housing and the new-supplied toner together, and makes the carrier and the toner of the two-component developer charged.

On the other hand, in the housing of the development unit, a magnetic member is disposed around a bearing portion, and the carrier in the developer is attracted to the magnetic member, thereby to form a so-called magnetic seal.

SUMMARY

An object of the invention is to provide a development unit which suppresses occurrence of toner cohesion accompanied by heat generation of a sliding portion in the development unit.

The above problem may be achieved by the following invention. Namely, the development unit of the invention has the following features.

According to an aspect of the invention, a development unit includes a developer accommodating part that accommodates a developer therein, a developer stirring-transporting member that transports the developer in the developer accommodating part while stirring the developer, a bearing part that receives a rotating shaft of the developer stirring-transporting member, a magnetic member that is located between the bearing part and the developer accommodating part and fixed around the rotating shaft, and a stirring member that is spaced apart from the magnetic member so as to be opposed to the magnetic member and that is arranged at the rotating shaft of the developer stirring-transporting member.

According to the aspect of the invention, it is suppressed that the developer attracted to the magnetic member stays on the rotating shaft and the toner coheres.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiments of the invention will be described in detail based on the following figures, wherein:

FIG. **1** is a sectional view showing a constitutional example of a development unit in an exemplary embodiment of the invention;

FIG. **2** is a transverse sectional view showing a constitutional example of a rotating roll in a first exemplary embodiment of the invention;

FIG. **3** is a sectional view taken along a line A-A in FIG. **2**, explaining the structure of a stirring member in the first exemplary embodiment;

FIG. **4** is a transverse sectional view showing a constitutional example of a rotating roll in a second exemplary embodiment of the invention;

FIG. **5** is a sectional view taken along a line B-B in FIG. **4**, explaining the structure of a stirring member in the second exemplary embodiment;

FIG. **6** is a transverse sectional view showing a constitutional example of a rotating roll in a third exemplary embodiment of the invention;

FIG. **7** is a sectional view taken along a line C-C in FIG. **6**, explaining the structure of a stirring member in the third exemplary embodiment;

FIG. **8** is a transverse sectional view showing a constitutional example of a rotating roll in a fourth exemplary embodiment of the invention;

FIG. **9** is a sectional view taken along a line D-D in FIG. **8**, explaining the structure of a stirring member in the fourth exemplary embodiment; and

FIG. **10** is a schematic diagram showing a constitutional example of an image forming apparatus of the invention used in an image forming method.

DETAILED DESCRIPTION

Embodiments of the invention will be described below. In order to explain the exemplary embodiments of the invention in detail, firstly an outline of a development unit in the exemplary embodiment will be explained, and thereafter the stirring constitution of a magnetic seal portion in a developer stirring-transporting member of the development unit will be described in detail. The developer stirring-transporting member in each exemplary embodiment means including a paddle member and a stirring roll described later. Taking a stirring roll as an example of the developer stirring-transporting member, and taking two-component developer composed of toner and carrier as an example of developer, the exemplary embodiments will be described below.

As shown in FIG. **1**, a development unit **2** in the exemplary embodiments is constituted so that a development roll **5** is exposed through an opening provided in a housing **3**. The development roll **5** is arranged oppositely to a photoreceptor **1** that is a charged body, and a comparatively narrow gap is formed between the development roll **5** and the photoreceptor **1**. The photoreceptor **1** is rubbed with a toner brush formed on a surface of the development roll **5**, and toner is moved onto an electrophotographic latent image formed on the photoreceptor **1**, whereby the electrophotographic latent image is made visible as a toner image. Further, in the development unit **2**, a paddle member **10** is disposed in a position close to the development roll **5**, and a stirring roll **20** is disposed in a

position where the developer is supplied. On a surface of the paddle member **10**, many projecting strips are arranged in a projecting state toward a feed direction, and feed out the developer toward the development roll **5**. Further, to a rotating shaft **21** of the stirring roll **20**, many disc-shaped members **23** (shown in FIGS. **2**, **4**, **6** and **8**) made of metal (for example, aluminum) are attached in a skewering manner in an inclined state at a predetermined angle to the rotating shaft **21**. By rotating the stirring roll, the developer is stirred with the disc-shaped members.

First Exemplary Embodiment

A stirring roll in a first exemplary embodiment will be described with reference to FIGS. **2** and **3**. In order to support a rotating shaft **21** of a stirring roll **20**, a bearing **22** is provided at a bearing portion of a frame **4** of a housing. Further, oppositely to the bearing **22**, a magnetic member **26** is disposed around the bearing portion in the frame **4**. The magnetic member **26** uses an arbitrary magnetic member, and is disposed by embedding a disc-shaped magnetic in the frame **4**. Further, on the bearing portion side of the rotating shaft **21**, a stirring member **30** is provided oppositely to the magnetic member **26**.

Further, in the stirring member **30** of the stirring roll in the exemplary embodiment, as shown in FIG. **3**, a disc-shaped member **32** is disposed at the rotating shaft **21** on the bearing portion side, and one and more rod-shaped member **34** are provided at the disc-shaped member **32** so as to protrude toward the magnetic member **26**. Hereby, a developer **40** accumulating on the rotating shaft **21** moves continuously or sequentially, whereby it is suppressed that the developer **40** stays and accumulates on the rotating shaft **21**. Further, the leading end of the rod-shaped member **34** and the magnetic member **26** are spaced d-dimension apart so that the developer attracted to the magnetic member **26** can be held between them.

In the exemplary embodiment, the developer attracted to the magnetic member **26** moves continuously or sequentially by the stirring member **30** provided at the rotating shaft **21**. Hereby, it is suppressed that the developer attracted to the magnetic member **26** stays on the rotating shaft for a long time and the toner coheres. For example, even in case that heat is generated by the rotation in a sliding portion between the rotating shaft **21** of the development unit and the bearing portion, it is suppressed that the developer coheres on the rotating shaft **21**. By suppressing the cohesion of the developer on the rotating shaft **21**, for example, wear of the bearing of the bearing portion is suppressed and an increase in drive torque of the rotating shaft **21** is prevented.

The stirring member **30** is formed of metallic material or resin material. From viewpoints of low thermal conductivity from the rotating shaft **21** and easiness in processing, the resin material may be the metallic material. As the resin material, from a viewpoint of strength, for example, ABS resin (acrylonitrile-butadiene-styrene resin), or resin in which glass fiber is filled is used. Further, in order to give opposite magnetic property to the magnetic property of the magnetic member **26** to the stirring member **30**, for example, a magnetic material is dispersed and filled in the resin material forming the stirring member **30**. Here, as the magnetic material, for example, iron oxide, chromium oxide, cobalt, or ferrite is used.

Second Exemplary Embodiment

A stirring roll in a second exemplary embodiment will be described with reference to FIGS. **4** and **5**. The same components as those in the first exemplary embodiment are denoted by the same symbols, and their description will be omitted.

In the exemplary embodiment, on the bearing portion side of a rotating shaft **21**, a stirring member **50** is provided on the rotating shaft **21**. Hereby, a developer **40** accumulating on the rotating shaft **21** moves continuously or sequentially, whereby it is suppressed that the developer **40** stays and coheres on the rotating shaft **21**. The stirring member **50** in the exemplary embodiment, as shown in FIG. **5**, is composed by one and more plate-shaped members **52**, and, in consideration of preventing developer accumulation, the plate-shaped member **52** may be formed in the shape of a blade which becomes thinner toward its leading end. Further, the plate-shaped member **52** and a magnetic member **26** are spaced d-dimension apart so that the developer attracted to the magnetic member **26** can be held between them. Further, since the material of the stirring member **50** is the same as the material of the above-mentioned stirring member **30**, its description will be omitted here.

Third Exemplary Embodiment

A stirring roll in a third exemplary embodiment will be described with reference to FIGS. **6** and **7**. The same components as those in the first and second exemplary embodiments are denoted by the same symbols, and their description will be omitted.

In the exemplary embodiment, on the bearing portion side of a rotating shaft **21**, a stirring member **60** is provided on the rotating shaft **21**. Hereby, a developer **40** accumulating on the rotating shaft **21** moves continuously, whereby it is suppressed that the developer **40** stays and coheres on the rotating shaft **21**. The stirring member **60** in the exemplary embodiment is a brush-shaped member, in which a disc-shaped member **62** is disposed at the rotating shaft **21** on the bearing portion side as shown in FIG. **7**, and a brush member **64** is disposed at the disc-shaped member **62** so as to be opposed to a magnetic member **26**. Further, the brush-shaped member **64** and the magnetic member **26** are spaced d-dimension apart so that the developer attracted to the magnetic member **26** can be held between them. Further, since the material of the brush member **64** in the exemplary embodiment is the same as the material of the above-mentioned stirring member **30**, its description will be omitted here. As the brush member **64** in the exemplary embodiment, such a brush is used that a tip force per brush constituting the brush member **64** is 0.0012 g in case that a brush diameter is ϕ12 mm and the intrusion amount of the brush is 0.5 mm, or that a tip force is 0.0006 g in case that a brush diameter is ϕ10 mm and the intrusion amount is 0.5 mm. As a material of the brush member, for example, ABS resin (acrylonitrile-butadiene-styrene resin), or resin in which glass fiber is filled is used.

Further, the brush member **64** may use a material in which a magnetic material such as iron oxide, chromium oxide, cobalt, or ferrite is dispersed in ABS resin (acrylonitrile-butadiene-styrene resin), or in resin in which glass fiber is filled.

Fourth Exemplary Embodiment

A stirring roll in a fourth exemplary embodiment will be described with reference to FIGS. **8** and **9**. The same components as those in the first, second, third exemplary embodiments are denoted by the same symbols, and their description will be omitted.

In the exemplary embodiment, on the bearing portion side of a rotating shaft **21**, a stirring member **70** is provided on the

rotating shaft **21**. Hereby, a developer **40** accumulating on the rotating shaft **21** moves continuously, whereby it is suppressed that the developer **40** stays and accumulates on the rotating shaft **21**. The stirring member **70** in the exemplary embodiment is a brush-shaped member, which is larger in elastic modulus of a brush member and softer than the brush member used in the third exemplary embodiment. The stirring member **70** in the exemplary embodiment, since it is the brush member, is smaller in mechanical stress onto the developer than the stirring members having the other shapes. In result, even in case that a low-melting toner is used in the two-component developer, stress onto the low-melting toner is reduced.

As shown in FIGS. **8** and **9**, a disc-shaped member **72** is disposed at the rotating shaft **21** on the bearing portion side, and a brush member **74** is disposed at the disc-shaped member **72** so as to be opposed to a magnetic member **26**. Further, the brush member **74** is arranged so as to come close to or come into contact with the magnetic member **26**, because the brush member **74** is softer than the brush member used in the third exemplary embodiment and the mechanical stress onto the developer is resultantly smaller. Since a material of the brush member **74** in the exemplary embodiment is the same material as the material of the above-mentioned stirring member **30**, its description is omitted here. As the brush member **74** in the exemplary embodiment, such a brush is used that a tip force per brush constituting the brush member **74** is 0.0006 g in case that a brush diameter is ϕ12 mm and the intrusion amount of the brush is 0.5 mm, or that a tip force is 0.00011 g in case that a brush diameter is ϕ10 mm and the intrusion amount is 0.5 mm. As a material of the brush member, for example, ABS resin (acrylonitrile-butadiene-styrene resin), or resin in which glass fiber is filled is used.

Further, the brush member **74** may use a material in which a magnetic material such as iron oxide, chromium oxide, cobalt, or ferrite is dispersed in the ABS resin (acrylonitrile-butadiene-styrene resin), or in the resin in which glass fiber is filled.

FIG. **10** is an entire constitutional view showing an example of an image forming unit in the exemplary embodiment.

Next, an example of the image forming apparatus in the exemplary embodiment will be described.

FIG. **10** is a schematic diagram showing a constitutional example of an image forming apparatus for forming an image by an image forming method in the exemplary embodiment. In the shown image forming apparatus **200**, four electrophotographic photoreceptors **401***a* to **401***d* are arranged in a housing **400** along an intermediate transfer belt **409** in parallel with one another. In the electrophotographic photoreceptors **401***a* to **401***d*, for example, the electrophotographic photoreceptor **401***a* can form an image of yellow, the electrophotographic photoreceptor **401***b* can form an image of magenta, the electrophotographic photoreceptor **401***c* can form an image of cyan, and the electrophotographic photoreceptor **401***d* can form an image of black.

The electrophotographic photoreceptor **401***a* to **401***d* can rotate in the predetermined direction (counterclockwise direction on the paper surface), and charge rolls **402***a* to **402***d*, development units **404***a* to **404***d*, first transfer rolls **410***a* to **410***d*, and cleaning blades **415***a* to **415***d* are arranged along its rotating direction. Toners of four colors of black, yellow, magenta, and cyan accommodated in toner cartridges **405***a* to **405***d* can be supplied to the development units **404***a* to **404***d*, respectively. Further, the first transfer rolls **410***a* to **410***d* come into contact with the electrophotographic photoreceptors **401***a* to **401***d*, respectively, through the intermediate transfer belt **409**.

Further, in a predetermined position in the housing **400**, an exposure unit **403** is arranged, which can irradiate optical beams emitted from the exposure unit **403** onto surfaces of the charged electrophotographic photoreceptors **401***a* to **401***d*. Hereby, in a rotation process of each electrophotographic photoreceptor **401***a* to **401***d*, charging, exposing, developing, first-transferring, and cleaning steps are performed in order, and toner images of the respective colors are multilayer-transferred on the intermediate transfer belt **409**.

Here, the charge rolls **402***a* to **402***d* bring conductive members (charge rolls) into contact with the surfaces of the electrophotographic photoreceptors **401***a* **401***d* to apply voltage uniformly to the photoreceptors, and charge the photoreceptor surfaces at a predetermined potential (charging step). Further, using a charge brush, a charge film, or a charge tube in addition to the charge roll shown in the exemplary embodiment, contact electrification type charging may be performed. Further, using a corotron or a scorotron, non-contact electrification type charging may be performed.

As the exposure unit **403**, can be used an optical system capable of causing the light from a light source such as a semiconductor laser, LED (light emitting diode), a liquid-crystal shutter, or the like to strike desirable image-wise on the surfaces of the electrophotographic photoreceptor **401***a* to **401***d*. In particular, when an exposure unit capable of exposing the photoreceptor surface to an incoherent light is used, interference fringes can be prevented from occurring between conductive substrates and photosensitive layers in the electrophotographic photoreceptors **401***a* to **401***d*.

As the development units **404***a* to **404***d*, can be used a general development unit which performs development by bringing the above-mentioned two-component developer for electrostatic charge image into contact or non-contact with the photoreceptor (development step). Such the development device is not particularly limited as long as the two-component developer for electrostatic charge image is used, and a known development unit can be selected appropriately according to a purpose. In a first transfer step, a first transfer bias having the opposite polarity to the polarity of the toner carried by image carriers is applied to the first transfer rolls **410***a* to **410***d*, whereby the toners of the respective colors are first-transferred in order from the image carriers to the intermediate transfer belt **409**.

Cleaning blades **415***a* to **415***d* are used in order to remove the residual toner adhered to the surface of each electrophotographic photoreceptor after the transfer step. The electrophotographic photoreceptor is thus cleaned and is then repeatedly subjected to the above image forming process. As examples of the material of the cleaning blade, there are urethane rubbers, neoprene rubbers, and silicone rubbers.

The intermediate transfer belt **409** is supported with a predetermined tension by a drive roll **406**, a back-up roll **408** and a tension roll **407**, and can rotate by rotation of these rolls without causing flexure. Further, a second transfer roll **413** is disposed so as to come into contact with the back-up roll **408** through the intermediate transfer belt **409**.

To the second transfer roll **413**, a second transfer bias having the opposite polarity to the polarity of the toner on the intermediate transfer medium is applied, whereby the toner is second-transferred from the intermediate transfer belt to a recording medium. The intermediate transfer belt **409** passing between the back-up roll **408** and the second transfer roll **413** is cleaned by a cleaning blade **416** disposed near the drive roll **406** or a static eliminator (not shown), and is then repeatedly

subjected to the next image forming process. Further, in a predetermined position in the housing **400**, a tray (a transferred medium tray) **411** is provided. Transferred media **500** such as paper in the tray **411** are transported in order by a transport roll **412** between the intermediate transfer belt **409** and the second transfer roll **413**, and further between two fixing rolls **414** adjacent to each other, and thereafter exhausted to the outside of the housing **400**.

In a process cartridge in the exemplary embodiment, as shown in FIG. **10**, the charge roll **402***a*, the electrophotographic photoreceptor **401***a*, the cleaning blade **415***a* and the development unit **404***a* are integrated, thereby to constitute, for example a process cartridge for black color. Similarly, the charge roll **402***b*, the electrophotographic photoreceptor **401***b*, the cleaning blade **415***b* and the development unit **404***b* are integrated, thereby to constitute a process cartridge for yellow color; the charge roll **402***c*, the electrophotographic photoreceptor **401***c*, the cleaning blade **415***c* and the development unit **404***c* are integrated, thereby to constitute a process cartridge for magenta color; and the charge roll **402***d*, the electrophotographic photoreceptor **401***d*, the cleaning blade **415***a* and the development unit **404***d* are integrated, thereby to constitute a process cartridge for cyan color.

The developer in the exemplary embodiment may be a two-component developer composed of toner and carrier.

The invention is applied to, for example, an image forming apparatus using an electrophotographic system, such as a copying machine or a printer.

The foregoing description of the exemplary embodiments of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obviously, many modifications and variations will be apparent to practitioners skilled in the art. The exemplary embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, thereby enabling others skilled in the art to understand the invention for various exemplary embodiments and with the various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalents.

What is claimed is:

1. A development unit comprising:

a developer accommodating part that accommodates a developer therein;

a developer stirring-transporting member that transports the developer in the developer accommodating part while stirring the developer;

a bearing part that receives a rotating shaft of the developer stirring-transporting member;

a magnetic member that is located between the bearing part and the developer accommodating part and fixed around the rotating shaft, and

a stirring member that is spaced apart from the magnetic member, that includes a projection portion being opposed to the magnetic member and that is arranged at the rotating shaft of the developer stirring-transporting member and is wider in circumference than the rotating shaft, the projection portion stirring the developer.

2. The development unit according to claim **1**, wherein the stirring member is brush-shaped solid.

3. The development unit according to claim **1**, wherein the stirring member is made of a material having a magnetism of an opposite polarity to that of the magnetic member.

4. A process cartridge comprising a development unit according to claim **1**.

5. An image forming apparatus comprising:

an image carrier;

a development member that develops an electrostatic image formed on the image carrier with a developer as a toner image;

a transfer member that transfers the toner image formed on the image carrier onto a transferred body; and

a fixing member that fixes the toner image transferred onto the transferred body,

wherein the development member comprises a development unit according to claim **1**.

6. A development unit comprising:

a developer accommodating part that accommodates a developer therein;

a developer stirring-transporting member that transports the developer in the developer accommodating part while stirring the developer;

a bearing part that receives a rotating shaft of the developer stirring-transporting member;

a magnetic member that is located between the bearing part and the developer accommodating part and fixed around the rotating shaft; and

a stirring member that is wider in circumference than the rotating shaft and that includes a projection portion being opposed to the magnetic member and stirring the developer with rotation of the rotating shaft, the developer attracted to the magnetic member.

7. The development unit according to claim **6**, wherein the stirring member is brush-shaped solid.

8. The development unit according to claim **6**, wherein the stirring member is made of a material having a magnetism of an opposite polarity to that of the magnetic member.

9. A process cartridge comprising a development unit according to claim **6**.

10. An image forming apparatus comprising:

an image carrier;

a development member that develops an electrostatic image formed on the image carrier with a developer as a toner image;

a transfer member that transfers the toner image formed on the image carrier onto a transferred body; and

a fixing member that fixes the toner image transferred onto the transferred body,

wherein the development member comprises a development unit according to claim **6**.

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